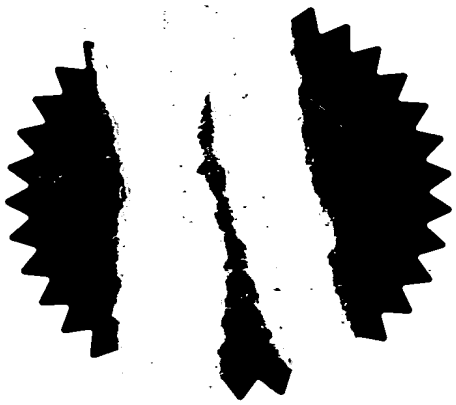
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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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Dated 27 January 2003

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23DEC02 E772673-1 D00611
P01/7700 0.00-0229727.3

Request for grant of a patent

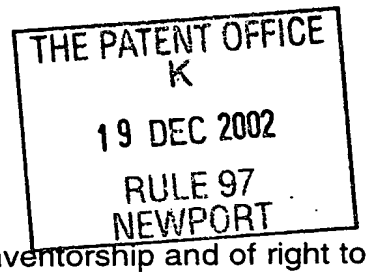
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1.	Your reference	**GB920020044GB1**
2.	Patent application number *(The Patent Office will fill in this part)*	0229727.3
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	INTERNATIONAL BUSINESS MACHINES CORPORATION Armonk New York 10504 United States of America
	Patents ADP number *(if you know it)*	51963700 1
	If the applicant is a corporate body, give the country/state of its incorporation	State of New York United States of America
4.	Title of the invention	**IMPROVED PASSWORD ENTRY**
5.	Name of your agent *(if you have one)*	C J Ling
	"Address for Service" in the United Kingdom to which all correspondance should be sent *(including the postcode)*	IBM United Kingdom Limited Intellectual Property Department Hursley Park Winchester Hampshire S021 2JN
	Patents ADP number *(if you know it)*	70016050 01

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority App No *(if you know it)*	Date of filing *(day/month/year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date or the earlier application	No of earlier application		Date of filing *(day/month/year)*

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Statement of inventorship and of right to grant of a patent

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1.	Your reference	**GB920020044GB1**
2.	Patent application number *(if you know it)*	0229727.3
3.	Full name of the or of each applicant	INTERNATIONAL BUSINESS MACHINES CORPORATION
4.	Title of invention	**IMPROVED PASSWORD ENTRY**
5.	State how the applicant(s) derived the right from the inventor(s) to be granted a patent	**By virtue of employment and by agreement**
6.	How many, if any, additional Patents Forms 7/77 are attached to this form?	
7.		I/We believe that the person(s) named over the page (and on any extra copies of this form) is/are the inventor(s) of the invention which the above patent application relates to. C.J. Ling Signature 17 December 2002 Date
8.	Name and daytime telephone number of person to contact in the United Kingdom	**C J Ling** Tel: 01962 815212

Enter full names, addresses and postcodes of the inventors in the boxes and underline the surnames

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If there are more than three inventors, please write their names and addresses on the back of another Patents Form 7/77 and attach it to this form

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REMINDER

Have you signed the form?

IMPROVED PASSWORD ENTRY

Field of the Invention

The invention relates to the entry of passwords, codes or identification numbers into data processing systems, Automated Teller Machines, locks or other security or access control devices. More particularly, the invention relates to the checking of the rhythm and tempo used for entry of the password, code or identification number.

Background of the Invention

IBM Technical Disclosure Bulletin v.30, n.5, October 1987, p.258, "Passwords for Computer Systems and Cipher Locks Containing Rhythm Patterns" discloses the use of a password with timing constraints such as the pauses between key-presses or the duration of the key-press being added. The pauses or duration are predefined and may be either "long" or short" and may be either relative to each other or absolute values.

US Patent 4,621,334 discloses a personal identification apparatus in which a mean time between keystrokes is used to determine whether a person attempting to gain access is the person who should be granted access to the system.

US Patent 4,805,222 discloses a method of verifying a person's identity by measuring the average inter-character time between successive pairs of keystrokes and comparing this with a pre-stored sample.

US Patent 5,557,686 discloses a user verification system in which vectors are constructed from user inputted samples and a neural network is used to determine whether the user inputted samples are similar to a sample entered for user verification.

US Patent 5,721,765 discloses a security system in which digits of an identification number are separated into two or more groups that must be entered with a predetermined time delay between each of the two or more groups.

US Patent 6,151,593 discloses a neural network which compares a timing vector extracted from the keystrokes a user has typed in with a training set to authenticate the identity of the user.

It would be desirable to allow entry of a password, code or identification number according to a rhythm and tempo defined by the user

unique identifier, but also that authentication is not given when the unique identifier is not entered by the authorised user.

In a variation of the preferred embodiment, said predetermined tolerance is explicitly set by the user. In some applications, it may be determined that a particular tolerance should be used and that the user should achieve this tolerance in order for the unique identifier to be accepted. For example, if during entry of the reference unique identifier, there is a large variation in the relative or absolute values of the inter-keystroke intervals, then that would allow future entry of the unique identifier with a large tolerance. It may be desirable to limit the tolerance or to explicitly set the tolerance.

The invention also provides a computer program comprising computer program code means adapted to perform the steps of any one of the methods described above.

Brief Description of the Drawings

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a flow diagram of a learning mode of an embodiment of the present invention;

Figure 2 is a screen image at step 102 of figure 1;

Figure 3 is a screen image after step 104 of figure 1;

Figure 4 is a screen image after step 106 of figure 1;

Figure 5 is a screen image of the error indication displayed at step 110 of figure 1;

Figure 6 is a flow diagram of a secure mode of an embodiment of the present invention;

Figure 7 is a screen image of the error indication displayed at step 614 of figure 6;

Figure 8 is a screen image of the error indication displayed at step 610 of figure 6;

Figure 9 is a screen image of the error indication displayed at step 618 of figure 6; and

Figure 10 is a screen image of the tempo checking portion of the present invention.

Detailed Description of the Invention

When a password, code or identification number is entered into a system by a user, there is typically a rhythm associated with the entry of

consists of. In alternative embodiments, this first entry of the password could be used as part of the learning process.

At step 106 of figure 1, a second entry of the password is made. Figure 4 shows a screen shot taken after the second entry of the password has been made. As each character of the password is entered, it is displayed in the message box 214 with the elapsed time interval between entry of each character in ms shown. Additionally, an acceptable range of time intervals computed using the rhythm tolerance may be shown. In the example of figure 4, this is not shown until a third entry of the password had been made, although this is not an essential feature of the invention and it could be shown after a first entry, or a second entry or a subsequent entry of the password.

When the Enter key or another key representing completion of the password entry process is pressed, then processing moves to step 108 of figure 1. If the second entry of the password matched the first entry of the password, the words "Password accepted." are displayed and the learn count window 218 now displays a learn count of 1. Processing moves to step 112 of figure 1 where an acceptable range of rhythm values is set. As an example, the message window of a subsequent entry might show:

```
'f' (0 ms)   [Range: 0 -> 0] PASS
'r' (265 ms)  [153 -> 253] FAIL (Slow)
'e' (203 ms)  [153 -> 253] PASS
'd' (157 ms)  [117 -> 195] PASS
Password accepted.
```

In the example above, the acceptable rhythm range has been set between 153 ms and 253 ms for the time interval between entry of "f" and "r", that is the time interval for the initial entry with a 25% tolerance applied. Similarly, for the time interval between entry of "r" and "e" and for "e" and "d", where the ranges are 153 ms to 253 ms and 117 to 195 ms respectively. The time interval between entry of "f" and "r" was outside the acceptable range and so failed for that entry. The time intervals between entry of "r" and "e" and for "e" and "d" were within the acceptable ranges for those time intervals and so passed for those entries.

If the second entry of the password does not match the first entry of the password, processing passes to step 110 of figure 1. Figure 5 shows a screen shot taken after an incorrect second entry of the password has been made. The words "Password text incorrect." and "Password not accepted." are displayed in the message window 214 and the learn count displayed in

accepted" messages are displayed in the message box (214 in figure 9) and an indication (802 in figure 9) is provided that the password is not accepted. Processing returns to step 606 to accept the entry of password. If all of the time intervals fall within the acceptable ranges, then at step 620 the password is accepted and a "Password accepted" message is displayed in the message box (214 in figure 7) and an indication (702 in figure 7) is displayed that the password is accepted.

In addition to checking the rhythm of entry of the password, the tempo is checked. In the context of this patent application, tempo is taken to mean relative measures of the time interval between the entry of each character or number of a password, code or identification number. That is, for example, if the characters being entered are "fred", then the interval between entering "f" and "r" might be 203 mS, the interval between entering "r" and "e" might also be 203 mS and the interval between entering "e" and "d" might be 156 mS. The first inter-character interval, that is, the interval between entering "f" and "r", may be used as an "anchor" for checking the relative timing for the rest of the password. The second and subsequent inter-character intervals are divided by this first interval to give values for the tempo. So the Tempo value for the interval between entering "r" and "e" would be 203 mS divided by 203 mS, that is 1.00 and the Tempo value for the interval between entering "e" and "d" might be 156 mS divided by 203 mS, that is 0.77. In an alternative embodiment, the average of the inter-character intervals may be used as an "anchor".

Also, in the context of this patent application, Tempo Tolerance is taken to mean the variation from these Tempo (relative) values that are permitted for the rhythm of the entry of the password, code or identification number to be accepted. For example, using the intervals mentioned above, with a Tempo Tolerance of 25%, a Tempo value of 0.75 to 1.25 (1.00 plus or minus 25%) might be acceptable for the interval between entering "r" and "e" and a range of 0.58 to 0.96 (0.77 plus or minus 25%) might be acceptable for the interval between entering "e" and "d".

As for the rhythm aspect of password entry, the system into which the password is entered must learn the tempo associated with a password when it is first entered. The system does this by using a Learning Mode and a Secure Mode in which the password is entered and the tempo is learnt.

Figure 10 shows a program window 1000 with a window title 202 of "Reference Password: "fred". A Rhythm Tolerance slider 204 is set to an initial value of 25% and a Tempo Tolerance slider 1002 is set to an initial value of 25%. Tick-box 1004 is included to enable Tempo checking. Message window 214 shows the elapsed time interval between entry of each character

CLAIMS

1. A method of authenticating a user comprising the steps of:

providing, by the user, a unique identifier, the unique identifier comprising both a sequence of keystrokes and the inter-keystroke intervals associated with provision of those keystrokes;

comparing the unique identifier provided by the user with a reference unique identifier by:

comparing the absolute inter-keystroke intervals of the unique identifier with the absolute inter-keystroke intervals of the reference unique identifier and returning a true indication if the absolute inter-keystroke interval of the unique identifier is within a predetermined tolerance of the absolute inter-keystroke interval of the reference identifier;

comparing the relative inter-keystroke intervals of the unique identifier with the relative inter-keystroke intervals of the reference unique identifier and returning a true indication if the relative inter-keystroke interval of the unique identifier is within a predetermined tolerance of the relative inter-keystroke interval of the reference identifier;

authenticating said user if both said absolute comparison step and said relative comparison step return a true indication.

2. A method as claimed in claim 1, wherein said relative inter-keystroke intervals are the ratio of the inter-keystroke intervals and the inter-keystroke interval between entry of the first of said sequence of keystrokes and the second of said sequence of keystrokes.

3. A method as claimed in claim 1, further comprising the step of entry by the user of the reference unique identifier and wherein said predetermined tolerance is determined during said step of entry by the user of the reference unique identifier.

4. A method as claimed in claim 3 wherein said predetermined tolerance is explicitly set by the user.

5. A computer program comprising computer program code means adapted to perform the steps of any one of claim 1 to claim 4.

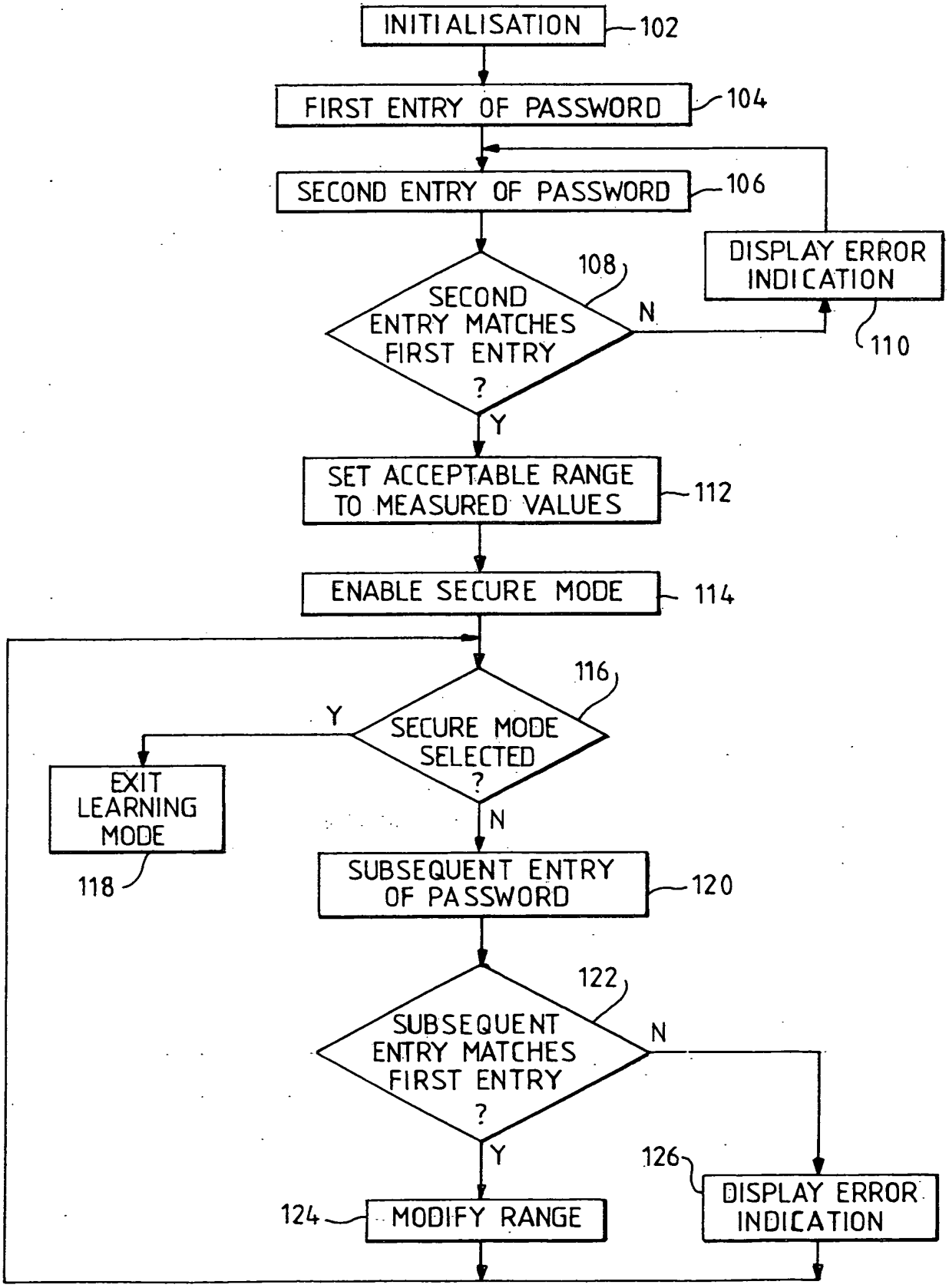

INITIALISATION
102
FIRST ENTRY OF PASSWORD
104
SECOND ENTRY OF PASSWORD
106
SECOND ENTRY MATCHES FIRST ENTRY ?
108
N
DISPLAY ERROR INDICATION
110
Y
SET ACCEPTABLE RANGE TO MEASURED VALUES
112
ENABLE SECURE MODE
114
SECURE MODE SELECTED ?
116
Y
EXIT LEARNING MODE
118
N
SUBSEQUENT ENTRY OF PASSWORD
120
SUBSEQUENT ENTRY MATCHES FIRST ENTRY ?
122
N
Y
MODIFY RANGE
124
DISPLAY ERROR INDICATION
126

FIG. 1

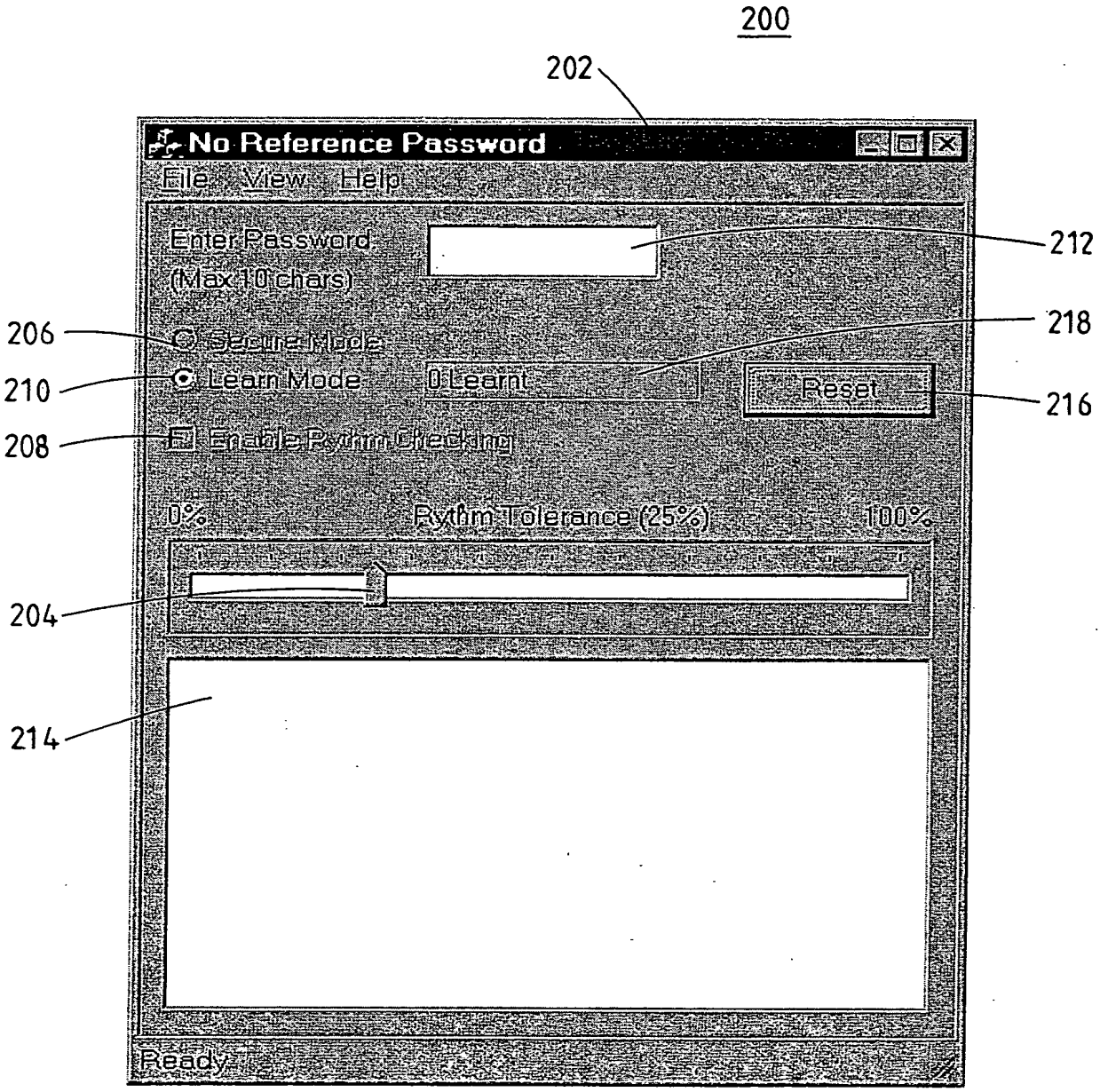


FIG. 2

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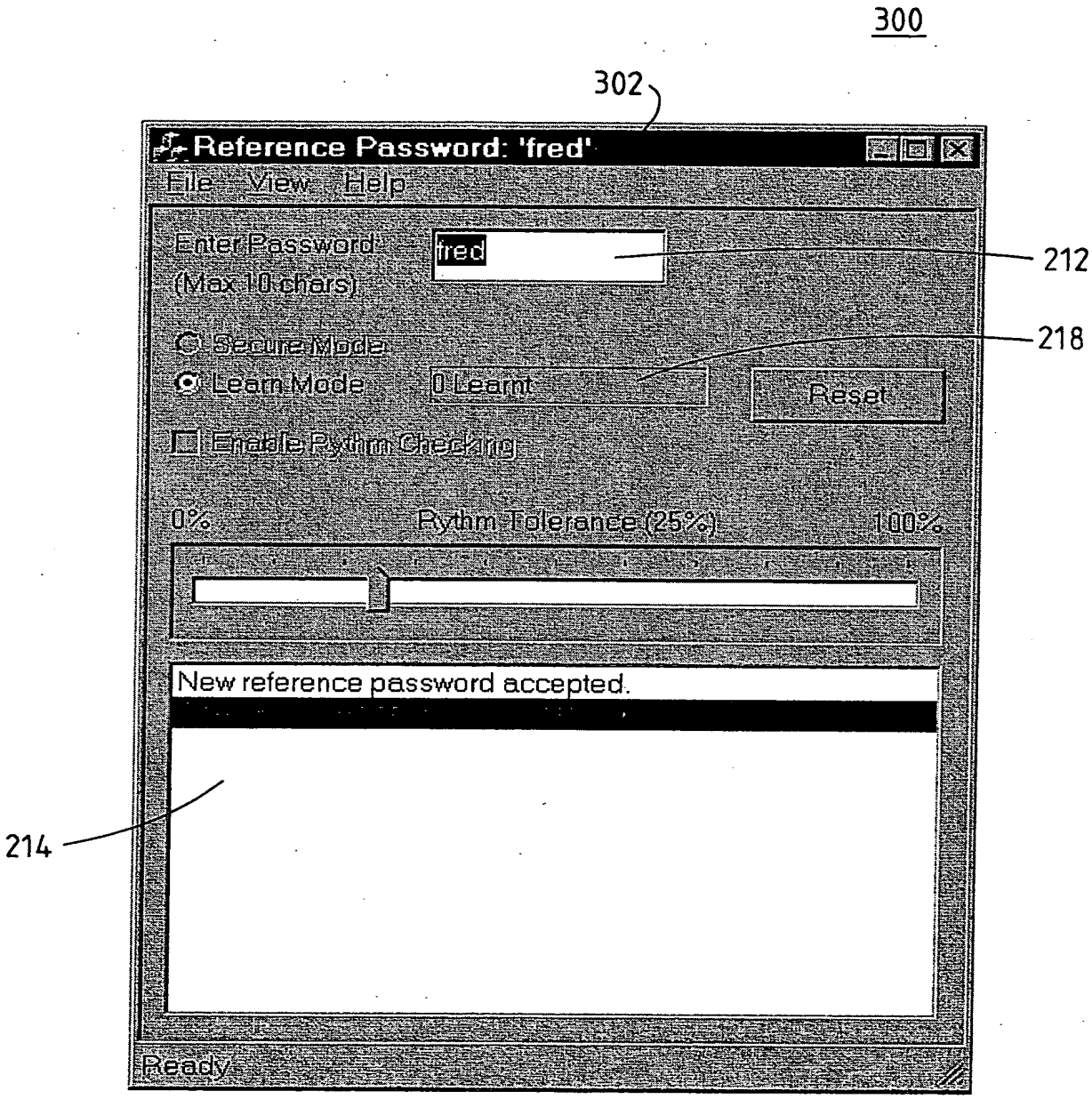


FIG. 3

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400

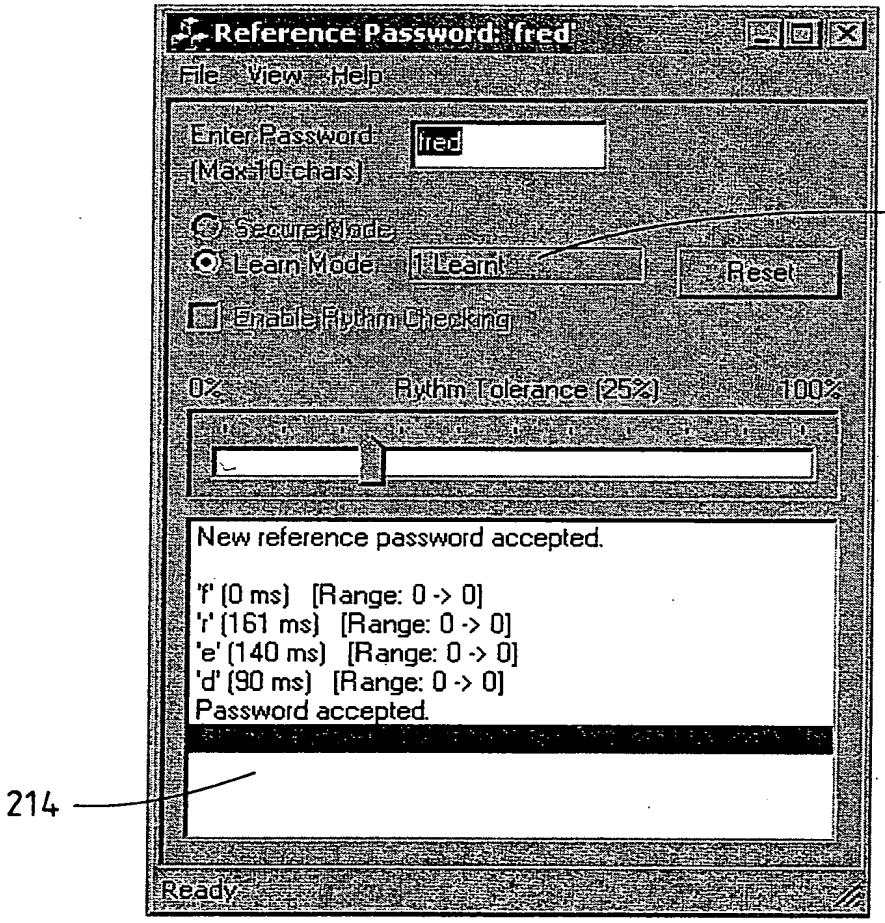
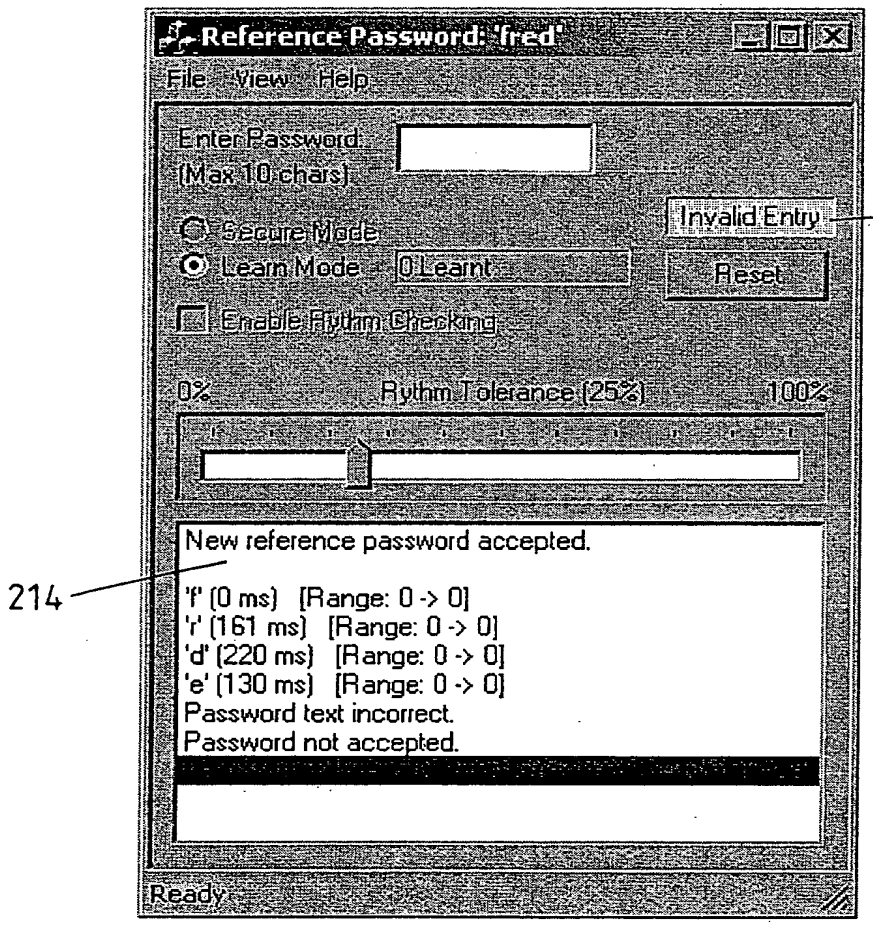


FIG. 4

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500



502

214

FIG. 5

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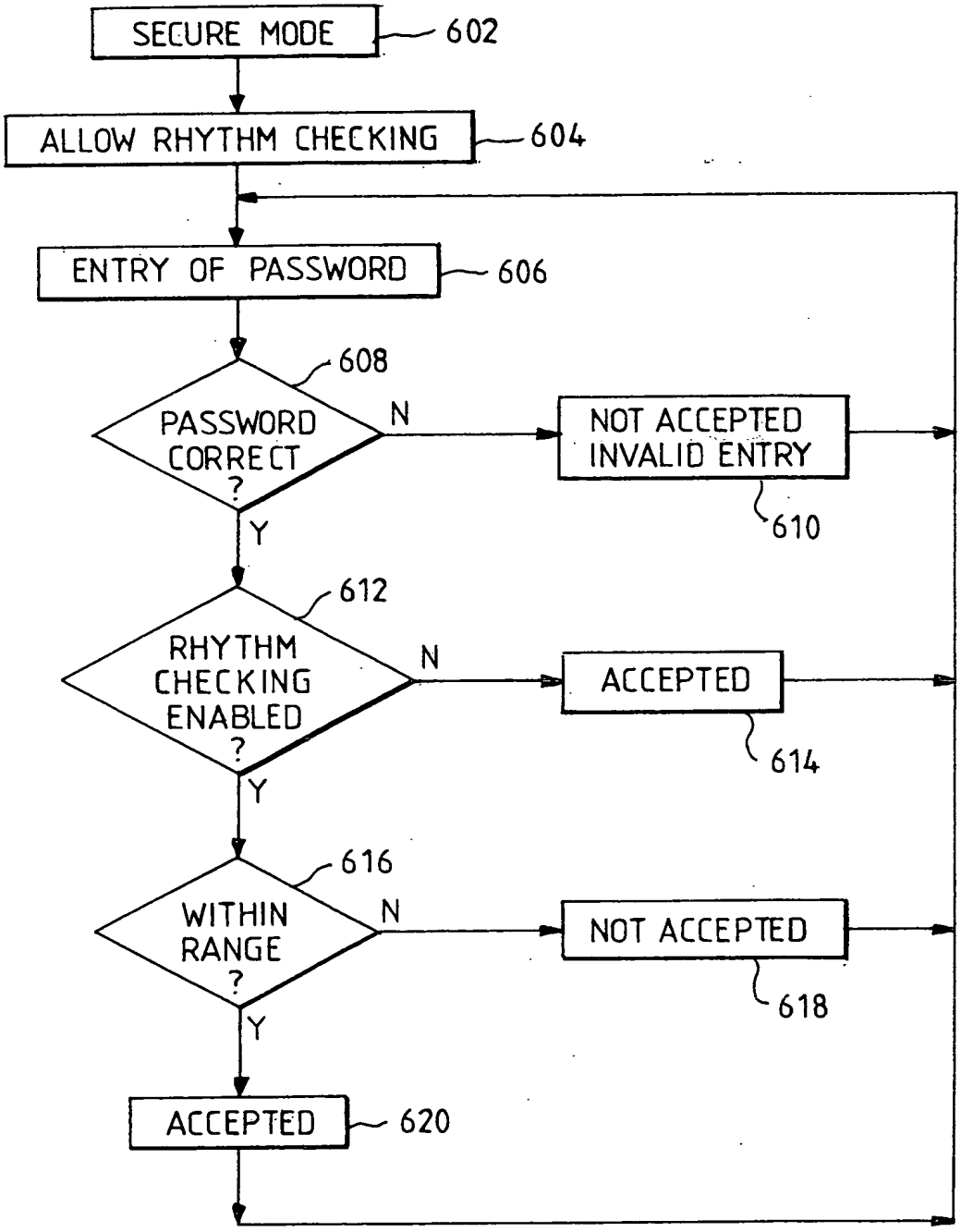

SECURE MODE
602
ALLOW RHYTHM CHECKING
604
ENTRY OF PASSWORD
606
608
PASSWORD CORRECT ?
N
NOT ACCEPTED INVALID ENTRY
610
Y
612
RHYTHM CHECKING ENABLED ?
N
ACCEPTED
614
Y
616
WITHIN RANGE ?
N
NOT ACCEPTED
618
Y
ACCEPTED
620

FIG. 6

700

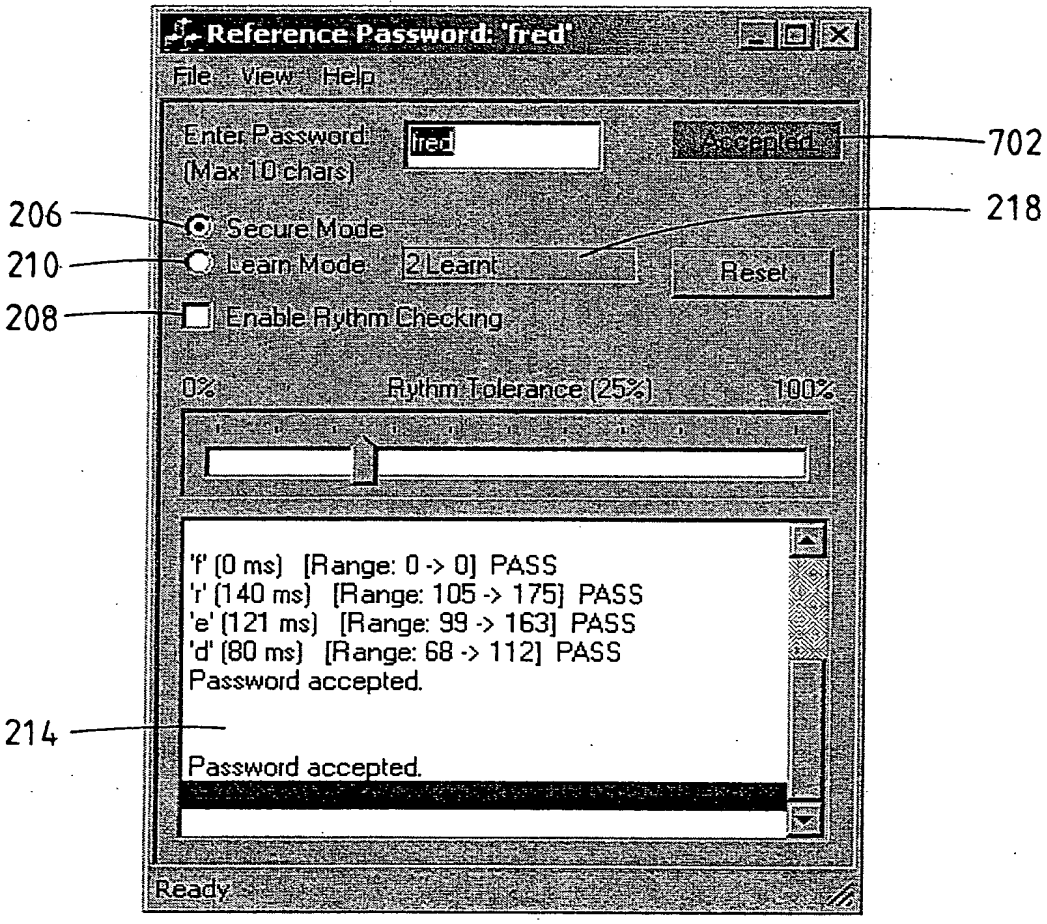


FIG. 7

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800

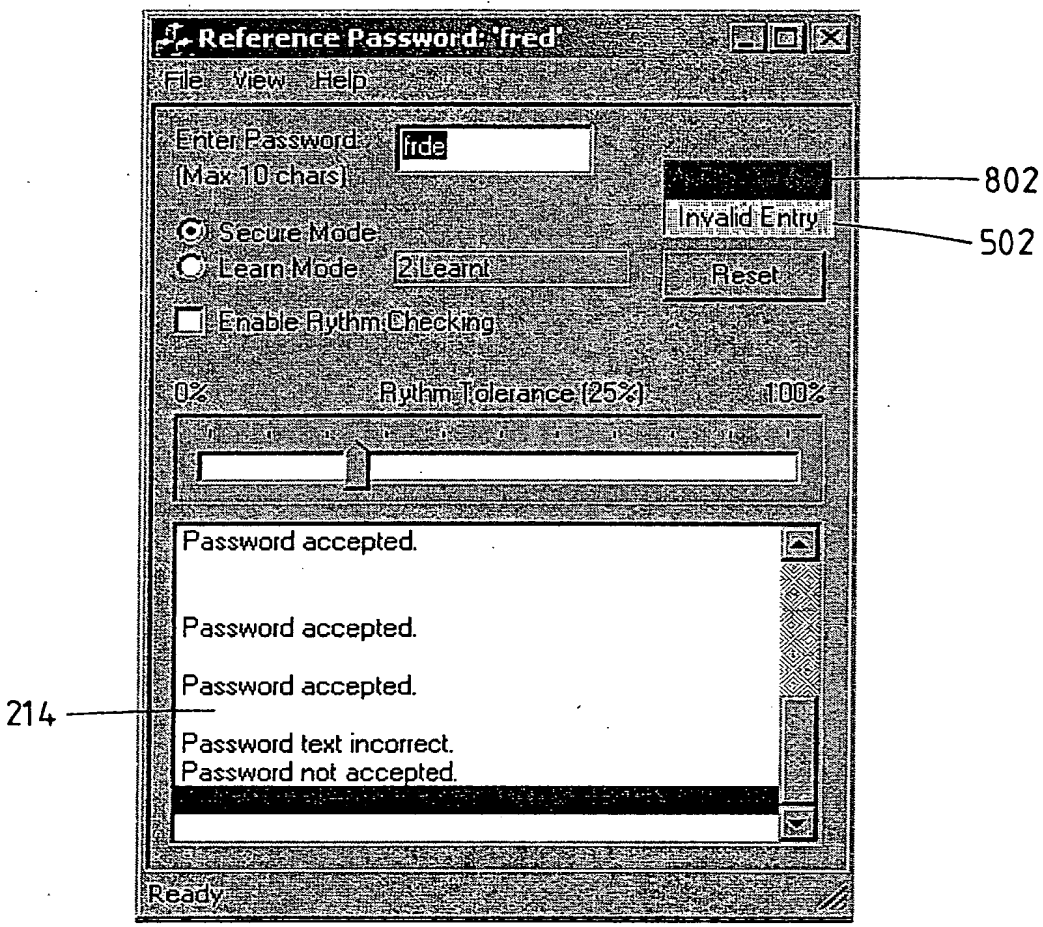


FIG. 8

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900

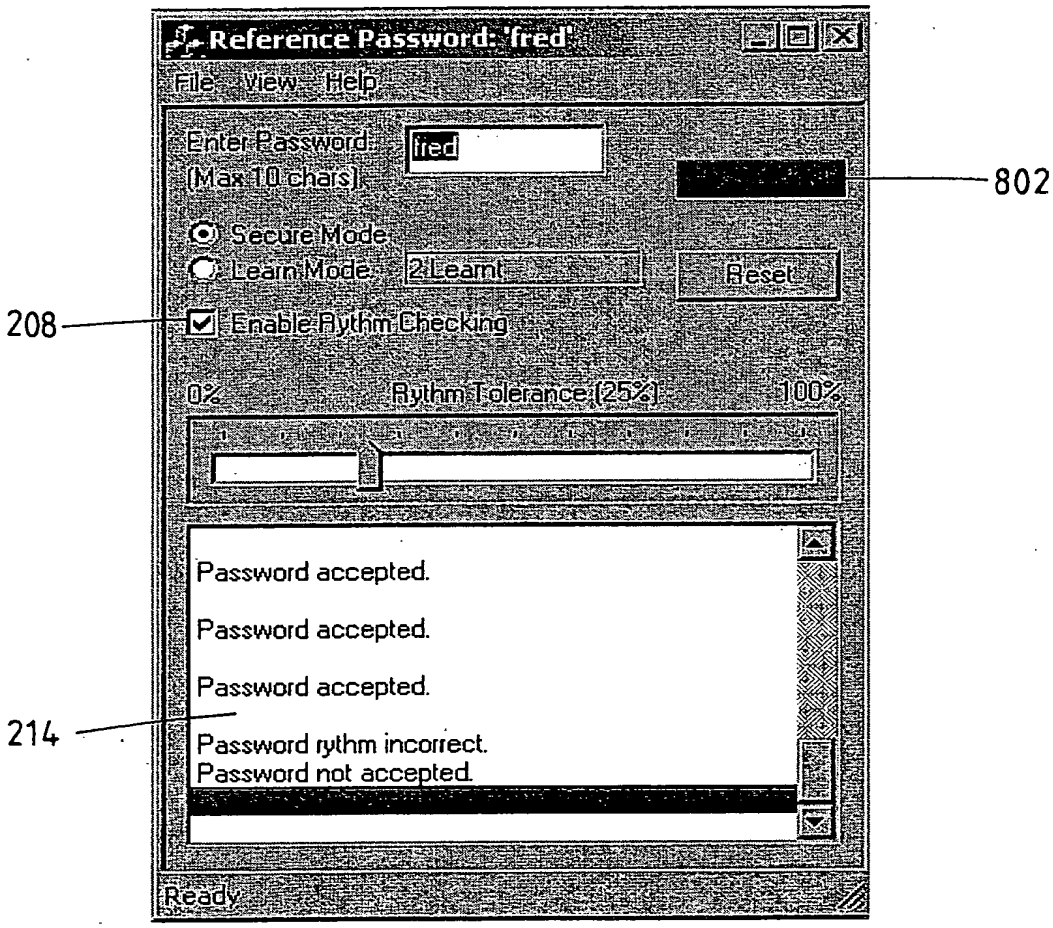


FIG. 9

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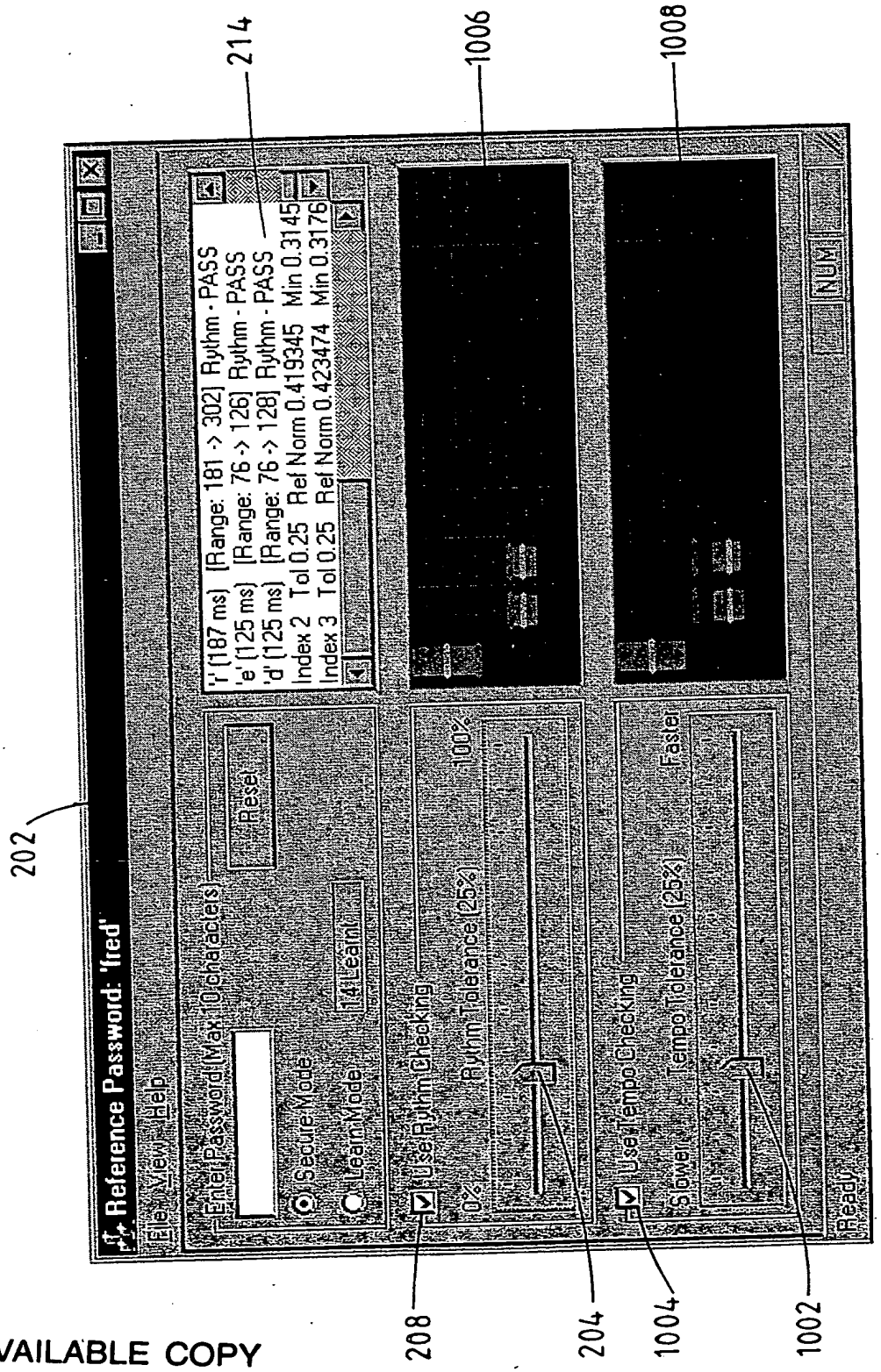


FIG. 10

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